



Meningococcal Disease Information and Investigation Guidelines

Description

Meningococcal disease can present in various clinical forms. The two most common presentations are meningococcal meningitis and meningococemia. Meningococcal meningitis is an inflammation of the meninges (the tissue that covers the brain and spinal cord), while meningococemia is an extremely severe, invasive infection of the blood stream. These disease presentations can occur independently or at the same time depending on the location of the bacteria in the body.

Infectious Agent

Meningitis can be caused by many different organisms, including bacteria, viruses, parasites, and fungi. Bacterial meningitis is generally more severe than viral meningitis. The term “meningococcal disease” refers only to disease caused by the bacteria *Neisseria meningitidis*; an aerobic, gram-negative, diplococcus. There are 13 serogroups of *N. meningitidis*. Serogroups A, B, C, Y, and W-135 account for nearly all cases of invasive disease worldwide. In the United States, serogroups B, C, and Y account for over 90% of cases.

Symptoms

Meningococcal disease signs and symptoms can include: high fever, headache, stiff neck, photophobia, nausea/vomiting, hypotension, weakness, confusion, shock, and coma. A petechial rash and/or purpura fulminans (systemic peripheral gangrene) may be observed in cases of meningococemia. The rash develops rapidly and usually appears around the armpits, groin, and ankles. The rash may have macules or vesicles and does not fade when direct pressure is applied. Symptoms in infants may be difficult to notice or present differently from older children and adults. Fever, irritability, lethargy, vomiting, and refusing foods can all be symptoms of meningococcal disease in infants. Once clinical disease presents, symptoms may develop rapidly within a few hours, or over the course of 1-2 days.

Incubation Period

The time from exposure to the development of clinical symptoms can range from 2-10 days, usually 3-4 days. The vast majority of individuals who come into contact with the bacteria will not develop meningococcal disease.

Incidence

The occurrence of meningococcal disease is highest during the winter and spring. Each year, approximately 1,500-2,500 cases (rate of 0.5-1.1 cases per 100,000 population) of meningococcal disease are reported in the United States. The highest rates of meningococcal disease occur among children less than 2 years old, although over 60% of cases occur in persons \geq 11 years old. The rates of disease among persons 11-19 are also higher than the general population. Rates of disease tend to decrease after infancy then increase during adolescence and young adulthood.

Transmission

The bacteria that cause meningococcal disease are contagious and spread from respiratory and nasopharyngeal secretions. Humans are the only reservoir. Fortunately, *N. meningitidis* bacteria are not as contagious as other respiratory pathogens such as rhinovirus (the common cold) and influenza virus. Most people exposed to *N. meningitidis* will not develop illness. Transmission of the bacteria on objects is generally not significant, although attention should be paid in daycares and other settings where children may place toys or other objects in their mouths. Casual contact is generally not enough to spread the bacteria to other individuals. Close, prolonged, or direct contact with oral or nasal secretions is necessary for transmission. Types of close contact include: kissing, sharing eating or drinking utensils, sharing cigarettes, performing CPR with breathing techniques, etc.

Communicability

Infection may be spread as long as there are live bacteria in nasal and throat secretions. A person is usually considered infectious 7-10 days prior to illness onset until 24 hours after appropriate antibiotic therapy is started. Generally, bacteria are no longer present in the nasopharyngeal tract after 24 hours of appropriate antibiotic therapy. Hospitalized cases should be placed under droplet precautions until 24 hours of appropriate treatment has been completed.

Groups with Increased Risk for Meningococcal Disease

- Household contacts of case patients and people with direct contact to case patient's oral and nasal secretions
- Infants
- People with concurrent or recent viral respiratory infections
- Individuals in crowded living situations such as multiple families living in a single unit, homeless shelters, or refugee camps
- Individuals with chronic illness
- People in group living situations, such as a college dormitory or military barracks
- People with immune deficiencies, those on medications that suppress immune function, or patients without spleens
- Individuals with active or passive exposure to smoking
- Travelers to areas with high levels of endemic or epidemic meningococcal disease
- Microbiologists or laboratorians who work with the *N. meningitidis* bacteria

Severity

Nearly all untreated cases of meningococcal disease result in death. Despite the susceptibility of the *N. meningitidis* bacteria to many common antibiotics, even with treatment 8-15% of cases are fatal. Among those who survive infection, approximately 10-20% will have long-term adverse effects (e.g., brain damage, hearing loss, loss of limb use, etc.).

Diagnosis

CSF from a lumbar puncture (LP or spinal tap) in conjunction with a blood isolate are the primary specimens used to diagnose meningococcal disease. Unless contraindicated, a lumbar puncture and blood sample should be taken immediately prior or concurrently to starting antibiotic therapy. CSF and blood cultures should be started as soon as possible to attempt to identify the infectious agent, as results may take up to 48 hours. Gram stains should immediately be done in effort to visualize the diplococci bacteria.

In the event a lumbar puncture is delayed, a blood specimen should be drawn followed by the initiation of antibiotic therapy before a CT scan is performed. The administration of antibiotics prior to collecting samples may result in no culture growth. In this case, other clinical and laboratory evidence can still be used to determine the likely cause of disease. CSF from a bacterial meningitis case may appear cloudy or milky, have increased protein, decreased glucose, and a high number of white blood cells (neutrophils usually predominate). PCR and latex agglutination may also be of use in cases suspected to be culture-negative due to the prior administration of antibiotics. Blood or CSF cultures must be submitted to the Michigan Department of Community Health (MDCH) Laboratory for serogrouping from every case of meningococcal disease.

Case Definition

MDCH uses the case definition for meningococcal disease developed by the Centers for Disease Control and Prevention (CDC). Normally sterile sites include: CSF, blood, joint fluid, pleural fluid, and pericardial fluid. Isolation from non-sterile sites such as urine, sputum, or nasopharyngeal samples does not meet the case definition. Approximately 5-10% of the population asymptotically carries *N. meningitidis* in their noses and throats; nasopharyngeal colonization is not considered invasive disease. Carriage is generally transient and usually resolves within several weeks.

Confirmed: Isolation of *Neisseria meningitidis*:

- from a normally sterile body site **OR**
- from purpuric lesions

Probable:

- detection of *N. meningitidis*-specific nucleic acid in a specimen obtained from a normally sterile body site, using a validated polymerase chain reaction (PCR) assay **OR**
- detection of *N. meningitidis* antigen
 - in formalin-fixed tissue by immunohistochemistry (IHC); or
 - in CSF by latex agglutination

Suspect:

- Clinical purpura fulminans in the absence of a positive blood culture, **OR**
- Gram-negative diplococci, not yet identified, from a normally sterile body site

Treatment

Appropriate antibiotic therapy should be started as soon as possible, at most within 24 hours of diagnosis. A table of appropriate therapy based on the clinical and laboratory findings available at the time of therapy initiation can be found below for bacterial meningitis. The normal duration of therapy for bacterial meningitis caused by *N. meningitidis* is at least 7 days, depending on the patient's clinical response.

Table 1: Recommended antibiotic therapy based on clinical and laboratory information available at the initiation of treatment for bacterial meningitis

Clinical / laboratory findings	Recommended therapy		Alternative therapies
Bacterial meningitis suspected, no lumbar puncture (LP) or LP delayed	Vancomycin and 3rd generation cephalosporin (ceftriaxone or cefotaxime)		In those > 50 years: vancomycin plus ampicillin plus 3rd generation cephalosporin
Presumptive identification of <i>N. meningitidis</i> from gram stain	Ceftriaxone or cefotaxime		Penicillin G, ampicillin, chloramphenicol, fluoroquinolone, or aztreonam
<i>N. meningitidis</i> isolated and susceptibility testing completed	Penicillin MIC < 0.1 µg/mL	Penicillin G or ampicillin	Ceftriaxone, cefotaxime, or chloramphenicol
	Penicillin MIC 0.1-1.0 µg/mL	Ceftriaxone or cefotaxime	Chloramphenicol, fluoroquinolone, or meropenem

Note: According to the Infectious Diseases Society of America (IDSA) these guidelines are intended to assist practitioners in making decisions about appropriate health care and are not intended to replace the physician's judgment with respect to certain patients or special clinical situations.

Table adapted from: IDSA Guidelines- Tunkel et al. Practice Guidelines for the Management of Bacterial Meningitis. Clinical Infectious Disease 2004:39 (1267-1284)

Prophylaxis

Antibiotic prophylaxis is recommended for close contacts who have had direct contact to the case patient during the 7-10 days prior to illness and up to 24 hours after appropriate antibiotic therapy was started. Prophylaxis for contacts should be started within 24 hours of the case patient's diagnosis. Prophylaxis administered greater than 14 days after exposure to the case is not considered beneficial. Generally, prophylaxis is not necessary for casual contacts in classrooms or work environments, or for emergency response professionals who have used standard precautions. Due to the rate of asymptomatic carriage of *N. meningitidis*, nasal swab screening is not considered useful in determining the need for prophylaxis or treatment. All contacts should be advised to monitor for the development of symptoms consistent with meningococcal disease, particularly fevers, rashes, and severe headache. Signs and symptoms will generally present within 2 weeks, but a small risk of disease may persist for up to 2 months.

Prophylaxis Cont.

Close contacts may include:

- Household members or anyone who has slept in the same household as the case
- Daycare or childcare contacts, includes staff and attendees
- People who have had direct contact with oral or nasal secretions from the case
- People who have shared food, beverage, toothbrush, eating utensils, or cigarettes with the case
- Individuals who have provided direct patient care for 4 or more hours during the infectious period
- Medical personnel who have had direct, unprotected contact with oral or nasal secretions such as performing CPR with airway support or intubation
- Anyone seated directly next to a case on a prolonged airline flight (≥ 8 hours)

Persons / settings to consider and evaluate for contact follow-up and prophylaxis:

- Family
- Friends
- Roommates
- Boyfriend/ girlfriend/ intimate partners
- Place of employment
- School (close friends of older children, generally not the entire classroom)
- Daycare
- Before or after school care programs
- Social gatherings (particularly college parties where drinking games and sharing of cigarettes may have occurred)
- Extracurricular and sports events
- Church groups
- Hospital and emergency medical personnel
- Seat mates with extended contact on transportation (plane, bus, etc.)

Table 2: Recommendations for prophylaxis against meningococcal disease

Drug	Age Group	Dosage	Duration and Route of Administration
Rifampin*	Children < 1 month old	5 mg/kg body weight every 12 hrs	2 days, oral administration
	Children \geq 1 month old	10 mg/kg body weight every 12 hrs	2 days, oral administration
	Adults	600 mg every 12 hrs	2 days, oral administration
Ciprofloxacin**	Adults	500 mg	Single dose, oral administration
Ceftriaxone	Children < 15 years old	125 mg	Single intramuscular dose
	Adults	250 mg	Single intramuscular dose

*Rifampin is **not** recommended for pregnant women. May decrease the reliability of oral contraceptives.

Ciprofloxacin is **not recommended for pregnant / lactating women and is generally not recommended for persons <18 years old. May be considered for use in children when no alternative therapy is available.

Table adapted from: Prevention and Control of Meningococcal Disease. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2005: 54; No. RR-7

Prophylaxis Cont.

Meningococcal pneumonia

Currently, in the United States, there are no definitive guidelines regarding prophylaxis for close contacts exposed to a meningococcal pneumonia case. Most public health agencies advise that prophylaxis should be given to close contacts of a meningococcal pneumonia case with invasive disease -where *N. meningitidis* is isolated from a sterile site (blood, CSF, joint, etc.). The recommendations are less clear when a case has clinically compatible disease, but *N. meningitidis* is isolated from only a sputum specimen. High rates of asymptomatic carriage in the nasopharyngeal tract make it difficult to determine whether the illness, in the absence of sterile site cultures, is truly due to *N. meningitidis*. Transmission of *N. meningitidis* due to meningococcal pneumonia appears to be rare and generally prophylaxis is not recommended. However, with the absence of CDC or clinical practice standard guidelines, in cases of suspected meningococcal pneumonia without clear evidence of invasive disease, physicians and public health professionals should use their best judgment when deciding whether prophylaxis of close contacts is appropriate.

Prevention

There are several ways to reduce the risk of meningococcal disease including: the use of meningococcal vaccine for appropriate groups; not sharing drinking glasses, water bottles, eating utensils, cigarettes, cosmetics or balms for the lips; stop smoking and avoid exposing children to second-hand smoke; and avoiding contact with oral and nasal secretions of ill individuals. Frequent hand washing should be encouraged. Staying up-to-date on recommended vaccinations for other respiratory diseases such as influenza and pneumococcal disease may also provide some degree of protection.

Vaccination

Three types of meningococcal vaccines are available against *N. meningitidis*. All are effective against serogroups A, C, Y, and W-135. The vaccines are **not** effective against serogroup B, which accounts for approximately 30% of cases in the U.S. The meningococcal conjugate vaccines, Menveo® or Menactra®, are the preferred vaccines for ages 2-55 years old, with Menactra also approved for use in children ages 9-23 months. The polysaccharide vaccine, Menomune®, is preferred for those > 55 years old.

- Meningococcal conjugate vaccine- Menveo® (MenACWY-CRM)
 - licensed for use in 2010
 - approved for use in people ages 2-55 years old
- Meningococcal conjugate vaccine- Menactra® (MenACWY-D)
 - licensed for use in 2005
 - approved for use in people ages 2-55 years old
 - licensed as a 2 dose series for ages 9 - 23 months old
- Meningococcal polysaccharide vaccine- Menomune® (MPSV4)
 - available since 1981
 - only vaccine licensed for use in people older than 55 years
 - may be given to pregnant women if deemed necessary by a physician
 - may be given to individuals aged 2-55 if both Menveo® and Menactra® are contraindicated or unavailable and the need is urgent

Prevention Cont.

Individuals recommended to be vaccinated for meningococcal disease:

- All adolescents aged 11 - 18 years old
- Children aged 9 months - 10 years with certain high-risk conditions
- Persons aged 19 - 55 years old who meet one of the following conditions: live in a college dormitory, are military recruits, have a damaged or removed spleen, have terminal complement component deficiency, are microbiologists working with *N. meningitidis*, or are traveling/reside in an area with hyperendemic or epidemic meningococcal disease
- Individuals in a defined risk group exposed to a meningococcal disease outbreak

Advisory Committee on Immunization Practices (ACIP) Meningococcal Vaccine Guidelines (Summarized in Table 3)

Current meningococcal ACIP guidelines recommend routine vaccination with one of the meningococcal conjugate vaccines, Menveo® or Menactra®, at age 11 or 12 years with a booster dose at age 16 years. Adolescents who receive their first dose of meningococcal vaccine at age 13-15 should receive a single booster dose between the ages of 16-18. Individuals who receive their first dose of vaccine on or after age 16 do not need a booster dose. Routine vaccination of healthy individuals who are not at increased risk for meningococcal disease is not recommended for children aged 9 months -10 years or after age 21 years.

Persons aged 2- 55 years with reduced immune response will require multiple doses of meningococcal conjugate vaccine. All adolescents aged 11-18 years with HIV should routinely receive 2 primary doses administered 2 months apart, followed by the age appropriate booster guidelines. Other HIV-infected individuals determined by a physician to be at increased risk of meningococcal disease should also receive 2 primary doses, 2 months apart. People with complement component deficiencies should receive two primary doses administered 2 months apart, and then receive a booster dose every 5 years. Those with functional or anatomic asplenia should receive 2 doses, 2 months apart and at least 4 weeks after completion of the pneumococcal conjugate vaccine series beginning at age 2 years with an initial booster 3 years later, then a booster every 5 years. Other persons at increased risk for meningococcal disease (microbiologists working with *N. meningitidis*, travelers to endemic areas, unvaccinated college freshmen, or unvaccinated military recruits, etc.) should receive a single dose of vaccine, followed by a booster if needed, based on age and continued risk.

Children ages 9-23 months at high risk for invasive meningococcal disease are recommended to receive 2 doses of Menactra®, 3 months apart with an initial booster 3 years later and then every 5 years, if the increased risk remains. High risk groups include children who have persistent complement component deficiencies (e.g. C5--C9, properdin, factor H, or factor D), are travelling to or residents of areas where meningococcal disease is hyperendemic or epidemic, or are in a defined risk group during a community or institutional meningococcal outbreak.

Table 3: Summary of ACIP meningococcal conjugate* vaccine recommendations

Age group	Risk group	Primary series	Booster dose
11-18 years old	Normal health	1 dose, preferably at age 11 or 12 years	Once at age 16 years if primary dose was given at age 11 or 12
			Once during age 16-18 years if primary dose was given at age 13-15 years
			No booster if primary dose given on or after age 16 years
	HIV-infected	2 doses, 2 months apart	Once at age 16 years if primary dose was given at age 11 or 12
			Once during age 16-18 years if primary dose was given at age 13-15 years
			No booster if primary dose given on or after age 16 years
2-55 years old	Functional or anatomic asplenia	2 doses, 2 months apart, beginning at age 2 years and ≥4 weeks after completion of PCV13 vaccine series	Initial booster 3 years after completing the primary series (if increased risk remains)
			Continued boosters at 5-year intervals after the initial booster (if increased risk remains)
	Persistent complement component deficiency†	2 doses, 2 months apart	Every 5 years
			At earliest opportunity if a 1-dose primary series was administered, then every 5 years after
	Prolonged increased risk for exposure‡	1 dose	Persons aged 2-6 years: after 3 years
			Persons aged 7 years and older: after 5 years (if increased risk remains)
9-23 months old**	High risk for invasive meningococcal disease§ (except for functional or anatomic asplenia)	2 doses, 3 months apart	Initial booster 3 years after completing the primary series (if increased risk remains)
		Catch-up dose if dose 2 is not received on schedule: at the earliest opportunity	Continued boosters at 5-year intervals after the initial booster (if increased risk remains)

* Meningococcal conjugate vaccines: Menactra® (MenACWY-D) or Menveo® (MenACWY-CRM)

** Only Menactra® (MenACWY-D) is licensed for use in children ages 9-23 months

† Such as C5--C9, properidin, or factor D

‡ Microbiologists working with N. meningitides, travelers to or residents of areas with hyperendemic or epidemic meningococcal disease, unvaccinated college freshmen living in a dormitory, or unvaccinated military recruits

§ Children who have persistent complement component deficiencies (e.g. C5--C9, properidin, factor H, or factor D), are travelling to or residents of areas where meningococcal disease is hyperendemic or epidemic, or are in a defined risk group during a community or institutional meningococcal outbreak

Table adapted from: Updated Recommendations for Use of Meningococcal Conjugate Vaccines --- Advisory Committee on Immunization Practices (ACIP), 2010. MMWR 2011: 60(03);72-76

Recommendations of the Advisory Committee on Immunization Practices (ACIP) for Use of Quadrivalent Meningococcal Conjugate Vaccine (Men ACWY-D) Among Children Aged 9 Through 23 Months at Increased Risk for Invasive Meningococcal Disease. MMWR 2011: 60(40);1391-1392

Contraindications and adverse events

Meningococcal vaccine is contraindicated in individuals who have had a severe (life-threatening) allergic reaction to previously administered meningococcal vaccine or any other vaccine component. People who have ever had Guillain-Barré Syndrome should consult with their doctor prior to getting vaccinated. Individuals who are moderately or severely ill should wait until they are recovered to receive meningococcal vaccine; those with mild illness can usually be vaccinated.

Most people will have no adverse effects from meningococcal vaccine. Some individuals will develop mild redness or pain at the injection site or a low grade fever. These side effects generally resolve after 1-2 days. Serious allergic reactions to the meningococcal vaccines are rare. Some cases of Guillain-Barré Syndrome have been reported by people after receiving Menactra®, however there are very few cases reported and it is still unknown if they are actually due to the vaccine.

Vaccination standing orders

Standing orders for the administration of meningococcal vaccine can be found on the Immunization Action Coalition's website at www.immunize.org. Specific links to the standing orders documents can be found below.

Standing Orders for Administering Meningococcal Vaccine to Children & Teens
<http://www.immunize.org/catg.d/p3081a.pdf>

Standing Orders for Administering Meningococcal Vaccine to Adults
<http://www.immunize.org/catg.d/p3081.pdf>

Proper vaccine storage and handling guidance for meningococcal vaccine can be found at: <http://www.cdc.gov/vaccines/recs/storage/guide/vaccine-storage-handling.pdf>

Surveillance for Outbreaks

In the U.S., >98% of meningococcal disease cases are sporadic. In order to ascertain whether an outbreak is occurring, clinical samples must first be collected to determine the serogroup of *N. meningitidis* causing disease and, if warranted, to conduct pulsed field gel electrophoresis (PFGE). Outbreaks will be caused by a single serogroup and are generally very closely related strains.

Guidelines to assist in determining whether an outbreak is occurring include: at least 3 or more confirmed or probable primary cases (no known exposure to another case of meningococcal disease), a time period of less than 3 months, and a primary attack rate of greater than 10 cases per 100,000 population. Please contact the MDCH Communicable Disease Division immediately at 517-335-8165 or at 517-335-9030 (after business hours), if you suspect an outbreak of meningococcal disease. The use of vaccine for prophylaxis may be considered in outbreak situations. A defined population must be determined and consultation with the local and state health departments should occur prior to undertaking any vaccination efforts.

Because up to 5-10% of people carry *N. meningitidis* asymptomatically in their nasopharynx, screening with nasopharyngeal swabs of asymptomatic individuals is not recommended in routine case contact investigations or outbreak settings. Only a small percentage (<1%) of asymptomatic carriers will go on to develop invasive disease.

Physician and Infection Control Responsibilities

- Report suspect or confirmed case within 24 hours to the local health department jurisdiction where the case patient resides.
- Administer prophylaxis to exposed on-site health care workers, as appropriate.
- Request your laboratory submit the mandatory culture specimens from blood or CSF to the Michigan Department of Community Health Laboratory for *N. meningitidis* serogroup typing. Instructions for sample submission can be found at: http://www.michigan.gov/documents/LSGNeisseria_Referred_Cultures_8258_7.doc
- Ensure terminal prophylaxis to eliminate nasopharyngeal carriage of *N. meningitidis* in case patient prior to discharge. Third-generation cephalosporins (ceftriaxone or cefotaxime) or ciprofloxacin are effective.
- From 2007-2008, 3 cases of infection with ciprofloxacin resistant *N. meningitidis* were reported in the U.S. While widespread resistance does not appear to be a concern at this time, physicians should report any suspected chemoprophylaxis failures as soon as possible to the local health department.

Local Health Department Responsibilities

- Enter meningococcal disease case into MDSS within 24 hours of report from physician or laboratory. Use the Meningococcal Disease case report form.
- Begin follow-up investigation within 24 hours of notification of case.
- Conduct case investigation and interview of case patient, parents, or others able to provide information. For adolescent and young adults, friends may be a good source of information as parents may not be aware of all direct contacts.
- Identify close contacts and recommend prophylaxis, the goal should be to identify all close contacts within 24 hours of case report.
- Advise close contacts to visit their health care provider to receive prophylaxis. Help arrange prophylaxis, as needed, for those without health care.
- Communicate with providers to ensure appropriate prophylaxis of contacts.
- Confirm that sterile-site culture specimen has been sent to the MDCH laboratory for serogroup typing.
- Provide education on signs and symptoms of meningococcal disease for potentially exposed individuals. Symptoms generally develop within 14 days.
- As needed, provide templates of letters for parents of school or daycare contacts, or letters for college or workplace settings.

Michigan Department of Community Health Responsibilities

- Provide consultation and recommendations on case investigation and prophylaxis, as needed, to healthcare providers and the local health departments.
- Review all cases of meningococcal disease submitted to the MDSS.
- Verify cases meet appropriate case definition guidelines.
- Maintain and enhance statewide surveillance data.
- Maintain serogroup surveillance data from specimens tested at the MDCH Lab.
- Assist in multi-county investigations as requested by the local health departments.
- Route out-of-state cases to appropriate jurisdictions.
- Coordinate investigation for out-of-state cases.
- Assist in the determination of sporadic vs. outbreak situations.

- Consult with the MDCH laboratory and request PFGE, when appropriate, for suspected outbreaks.
- Consult on the role of vaccination for control measures in an outbreak.

Resources

Centers for Disease Control and Prevention. Exposure to Patients with Meningococcal Disease on Aircrafts, 1999--2001. MMWR 2001; 50(23):485-9.

Centers for Disease Control and Prevention. Licensure of a Meningococcal Conjugate Vaccine for Children Aged 2 Through 10 Years and Updated Booster Dose Guidance for Adolescents and Other Persons at Increased Risk for meningococcal Disease --- Advisory Committee on Immunization Practices (ACIP). MMWR 2011; 60(30): 1018-1019.

Centers for Disease Control and Prevention. Licensure of a Meningococcal Conjugate Vaccine (Menveo) and Guidance for Use --- Advisory Committee on Immunization Practices (ACIP). MMWR 2010; 59(09): 273.

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Centers for Disease Control and Prevention. Prevention and Control of Meningococcal Disease Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2005; 54 (No. RR-7):1-21.

Centers for Disease Control and Prevention. Recommendations of the Advisory Committee on Immunization Practices (ACIP) for Revaccination of Persons at Prolonged Increased Risk for Meningococcal Disease. MMWR 2009; 58:1042-3.

Centers for Disease Control and Prevention. Revised Recommendations of the Advisory Committee on Immunization Practices (ACIP) for Use of Quadrivalent Meningococcal Conjugate Vaccine (MenACWY-D) Among Children Aged 9-23 Months at Increased Risk for Invasive Meningococcal Disease. MMWR 2011; 60(40): 1391-1392.

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Tunkel AR, Hartman BJ, Kaplan SL, et al. IDSA Guidelines: Practice Guidelines for the Management of Bacterial Meningitis. *Clinical Infectious Diseases* 2004; 39:1267-1284.

Vaccine Storage & Handling Guide: Protect Your Vaccine ~ Protect Your Patients. October, 2011. Centers for Disease Control and Prevention. Accessed October 19, 2011. Available at: <http://www.cdc.gov/vaccines/recs/storage/guide/vaccine-storage-handling.pdf>

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Winstead JM, McKinsey DS, Tasker S, et al. Meningococcal Pneumonia: Characterization and Review of Cases Seen Over the Past 25 Years. *Clinical Infectious Diseases* 2000; 30:87-94.

Wu HM, Harcourt BH, Hatcher CP, et al. Emergence of Ciprofloxacin-Resistant *Neisseria meningitidis* in North America. *New England Journal of Medicine* 2009; 360:886-892.